

The Status of Community Water Fluoridation in the United States

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Synopsis

Community water fluoridation has served the American public extremely well as the cornerstone of dental caries prevention activities for 45 years. The dental and general health benefits associated with the ingestion of water-borne fluorides have been well known by researchers for an even longer period. Continued research has repeatedly confirmed the safety, effectiveness, and efficiency of community water fluoridation in preventing dental caries for Americans regardless of age, race, ethnicity, religion, educational status, or socioeconomic level.

Despite the obvious benefits associated with this proven public health measure, slow progress has been made toward achieving the 1990 national fluoridation objectives as listed in "Promoting Health/Preventing Disease: Objectives for the Nation." This paper docu-

ments the lagging pace of community fluoridation by reviewing and analyzing data reported in "Fluoridation Census, 1985," a document published in late 1988 by the Public Health Service's Centers for Disease Control.

Failure to attain the 1990 objectives is attributable to a combination of circumstances, including their low priority within many local, State, and Federal health agencies, inadequate funding at all levels of government, lack of a coordinated and focused national fluoridation effort, failure of most States to require fluoridation, lack of Federal legislation mandating fluoridation, general apathy of most health professional organizations toward fluoridation, misconceptions by the public about effectiveness and safety and, finally, unrelenting opposition by a highly vocal minority of the lay public. In addition, fluoridation successes have not been consistent among States, with wide variation in accomplishments documented in the reported data.

While fluoridation still is one of the most cost-effective public health measures available to local, State, and Federal public health agencies, it remains significantly underused nearly a half century after its discovery. Without a major increase in emphasis at the highest policy levels within local, State, and Federal health agencies, fluoridation objectives currently proposed for inclusion in the year 2000 national health objectives are not likely to be achieved. More private sector involvement and better coordination of efforts among all levels of government will be necessary to make significant improvements in progress toward universal fluoridation of all public water supplies in the United States.

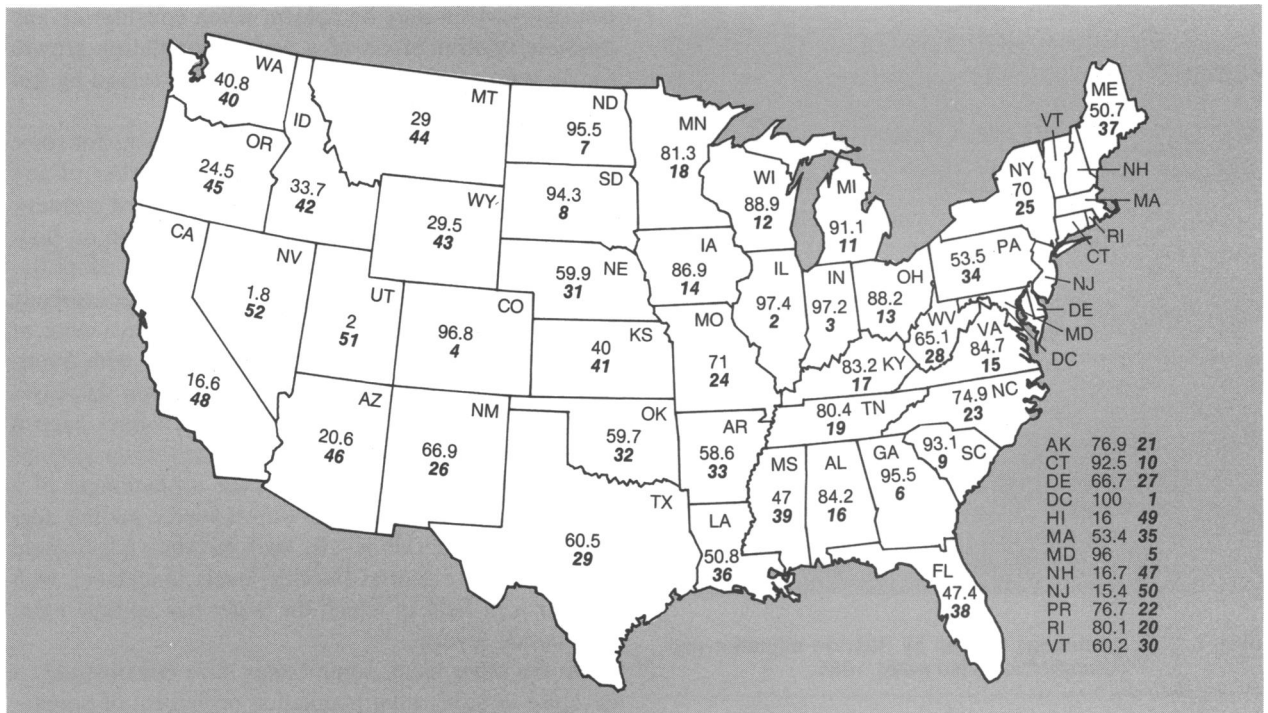
FLUORIDE IS AN ESSENTIAL trace element, crucial for the proper development of human teeth and bones and necessary in small amounts to prevent the ravages of dental caries (tooth decay). Fluoridation is the process of adding a carefully measured amount of a fluoride compound to community drinking water at a level which is optimum for the prevention of dental caries. In the United States, the optimal fluoride levels have been determined to be between 0.7 and 1.2 parts per million, depending on a community's annual mean daily temperature.

Community water fluoridation has been practiced in the United States since 1945 when the city of Grand Rapids, MI, first fluoridated its water supply as part of a classic Public Health Service (PHS) study (1). The process was developed after many years of epi-

demologic and clinical research that documented the prevention of dental caries in children and adults by certain levels of fluoride occurring naturally in some communities' drinking water (2,3). Because of its demonstrated effectiveness, efficiency, and safety, water fluoridation has long been a priority of the Public Health Service, most notably promoted in "Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention" (4) and in official PHS policy, most recently reaffirmed by Surgeon General C. Everett Koop in 1983 (5).

A number of national objectives for fluoridation and dental health were included in the Public Health Service's "Promoting Health/Preventing Disease: Objectives for the Nation" (6). One of the most significant of these oral health objectives stated that by 1990, at least

Figure 1. Percent of public water supply population using fluoridated water and State ranking (italic numerals)



SOURCE: Reference 7

95 percent of the U. S. population on community water systems was supposed to be receiving the benefits of optimally fluoridated water (6). This objective was not met by the target date. Moreover, without a major increase in emphasis among national, State, and local health policy makers, it is questionable whether the proposed year 2000 fluoridation objectives, currently in draft form and currently suggesting the same 95 percent target objective, will be able to be met (7).

The Last National Survey

The latest national data on community water fluoridation were released by the Centers for Disease Control in late 1988 and reflect the status of fluoridation as of December 31, 1985 (8). According to "Fluoridation Census, 1985," 130,430,834 people, or 61 percent of the U.S. population on public water supplies, consume water with optimal fluoride levels (8). Of that total, roughly 121 million people were on public water systems that were adjusting the fluoride content to optimum levels, while approximately 9 million people consumed water from community systems with adequate natural fluoride levels (8). Table 1 summarizes these most current data.

The number of beneficiaries of fluoridated water was up slightly from the 115,948,946 reported in 1980 (an increase of 12 percent), although the percentage of the public water supply population drinking optimally fluo-

rinated water remained approximately the same as that in 1980 (61 percent) (8, 9). Figure 1 displays the percent of the population on public water supplies using fluoridated water for each State and includes the State rankings (8). The slow but steady increase in the total national population served by fluoridated water over the first 40 years of implementation is illustrated by figure 2 (8). Despite the modest increase overall in the population receiving fluoridated water nationally, there exists notable variation among the States with regard to the adoption of this measure.

Data assembled in "Fluoridation Census, 1985" have been presented in several interesting and useful formats (8). For instance, both the total population and the percent of population on community water systems served by fluoridated water are presented according to State and Public Health Service region, including the States' rankings (8). Additionally, the number of public water systems adjusting fluoride content, the number of communities served by adjusted systems, and the number of systems and communities served by water with naturally occurring optimal fluoride levels, are also listed by State and PHS region (8). National totals for these data categories are summarized in table 1. Data summarizing much of the State-related information presented in the report's charts are presented in table 2. In addition, table 2 can be used to make comparisons of the 1985 State data with similar data presented from a previously published report of the 1980 fluoridation

Figure 2. Fluoridation growth by population, United States, 1945-85

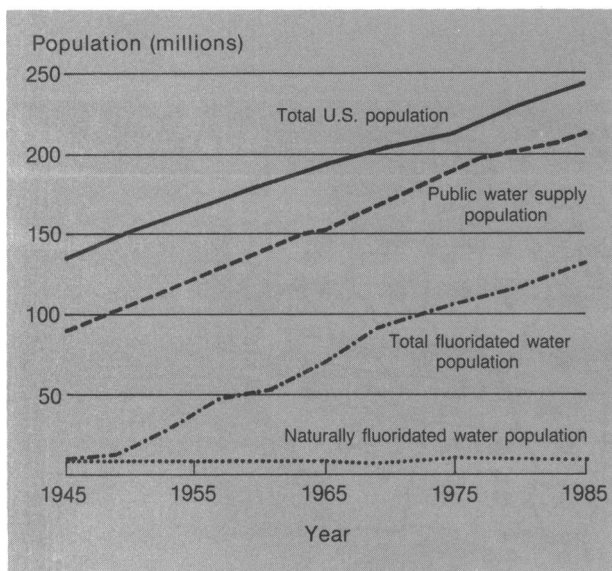


Table 1. U.S. population served by fluoride-adjusted and naturally fluoridated water, 1985

Type of fluoridation	Population	Systems	Communities
Adjusted	121,425,572	8,913	7,772
Natural	9,005,262	3,445	1,909
Total	1130,430,834	12,358	9681

¹The total U.S. population served by public water supplies is 211,730,873.
SOURCE: adapted from reference 8.

census (8, 9). Special populations served by fluoridated systems include school children benefiting through fluoridated school water supplies (169,970), American Indian and Alaskan Natives on reservations with fluoridated water systems (199,390), and 1,813,906 residents of American military bases with fluoridated systems (8).

Interestingly, while variation among States' implementation rates has always existed, significant shifts in relative rankings of some States occurred during the period from 1980 to 1985 as demonstrated by table 2 (8, 9). A total of 12 States improved their relative rankings by 5 or more positions during that 5-year interval. At the same time, 12 other States saw their relative rankings decrease by 5 or more positions, some of these despite noteworthy programmatic efforts to promote fluoridation. Other relative differences between States are apparent when changes in total population served by fluoridated water from 1980 to 1985 are compared (table 2). For example, six States increased their total population served by fluoridated water by more than 1 million persons each (8, 9). Table 2 also allows for a comparison of the percentage changes in States' total populations served by fluoridated water with percentage

increases or decreases in total populations (8, 9). This last comparison may be helpful when considering any possible relative effect of a State's population growth (or decline) on changes in the population served by fluoridated water systems.

There are a number of possible explanations for some of the positive changes in percent or number of any given State's population served by fluoridated systems. For the most part, increases in total population on fluoridated systems occur when new communities adopt fluoridation, when the population of communities already served by fluoridated systems increases, when rural or suburban areas are annexed by communities with fluoridated systems, or when there are population decreases in nonfluoridated areas. Other positive changes happen through the acquisition of nonfluoridated water systems by fluoridated ones or through the replacement of a nonfluoridated water source with a source having adequate natural fluoride levels, such as when a well field with inadequate natural fluoride levels is replaced with another well field in which the water has optimal natural fluoride levels.

On the other hand, some States have demonstrated a decrease in either total population or percent of population consuming fluoridated water. This could be the result, in part, of a decrease in a State's total population, an increase in the population residing in nonfluoridated areas, or a decrease in the population in certain fluoridated areas, such as the migration of population from naturally fluoridated rural areas to nonfluoridated urban areas.

In some instances, communities decide to cease fluoridation through administrative decision or public vote (both uncommon), or they change from one water source that is naturally fluoridated (such as a deep well) to one that is not fluoridated (such as a reservoir or river) when community growth outstrips the ability of the existing water system to meet increasing demand. On rare occasions, a fluoridating system may be acquired by a larger nonfluoridating system, or reconstruction of the water treatment facilities may result in a failure to maintain a fluoridation capability because of budget constraints associated with the new construction. Sometimes these negative changes in any given State's fluoridated population reflect only transitional situations which tend to remedy themselves when water plant development and construction or urban annexations stabilize within a region.

At the local level, 42 of the 50 largest cities in the United States currently fluoridate their water supplies (8). While Los Angeles, San Diego, and San Antonio (8), 3 of the 10 largest cities in the country, do not fluoridate, all have attempted to initiate fluoridation at various times in the last couple of decades.

Certain problems are inherent with the current data

reporting system and must be taken into consideration when analyzing and comparing any of the data reported in the 1980 and 1985 fluoridation census publications (8,9). First of all, total U. S. and individual State populations are based on U. S. census figures for 1980, but are only based on Bureau of Census estimates for 1985. A more accurate assessment of the trends can occur once the 1990 population census and 1990 fluoridation census have been completed and the official reports have been released. The statistics relating to populations served by community water systems and fluoridated public water supplies are based on a combination of reported estimates from local and State jurisdictions, estimates which may be difficult to make accurately because the boundaries of the reporting jurisdictions may or may not be consistent with the boundaries of the water distribution systems serving those jurisdictions. In addition, criteria for determining water distribution boundaries and definitions of water system populations are slightly different in 1985 from what they were in 1980. Furthermore, errors may occur in the collection, assembly, reporting, and interpretation of data as they are relayed from local to State to Federal levels. Finally, some jurisdictions, due to fiscal and human resource insufficiencies, suffer from the inability to collect, assemble, and report complete data for all water systems within their jurisdiction. Therefore, caution must be exercised when evaluating specific changes evident in each State as reported through the PHS fluoridation census publications. General trends, however, can be demonstrated quite adequately.

Legislation and Referenda

Only seven States currently mandate community water fluoridation (Connecticut, Georgia, Illinois, Minnesota, Nebraska, Ohio, and South Dakota), all enacting their legislation between 1965 and 1973 (10, 11). It is important to note that all States permit fluoridation of the water supply, even though they might not have mandated it for any or all communities through State action (10). It is also equally important to be aware that no State has ever prohibited fluoridation (10).

Recently, a renewed interest in mandatory statewide fluoridation legislation has been evident. In 1987, an unsuccessful attempt was made to enact mandatory fluoridation legislation for Hawaii through efforts of the State health department and community activists.

During the 1988-89 legislative session in Pennsylvania, a coalition of civic, labor, advocacy, health, professional, insurance, business, and trade groups, called the Partners for Better Oral Health, organized a similarly unsuccessful effort to have fluoridation mandated statewide. Repeating their efforts during the 1989-90 legislative session, the group succeeded in winning

Table 2. States' rankings in 1980 and 1985 by percentages of population on fluoridated community water systems and percentage changes in population served by fluoridated systems and in total population¹

State	Percent fluoridated	1985 rank	1980 rank	Fluoridation change		Total population change (percent)
				Population	Percent	
DC....	100.0	1	1	-12,151	-1.9	-1.9
IL.....	97.4	2	2	+1,082,662	+10.8	-1.1
IN....	97.2	3	18	+131,482	+3.7	+0.2
CO...	96.8	4	6	+1,020,357	+48.0	+12.5
MD...	96.0	5	4	+1,559	+0.0	+5.0
GA....	95.5	6	13	+435,238	+12.1	+10.5
ND....	95.5	7	14	+64,390	+15.0	+4.5
SD....	94.3	8	9	+34,159	+7.3	+2.6
SC....	93.1	9	29	+813,155	+52.7	+7.7
CT....	92.5	10	3	-55,815	-2.3	+2.4
MI....	91.1	11	17	+213,591	+3.6	-2.3
WI....	88.9	12	22	+114,690	+4.1	+1.6
OH....	88.2	13	21	+1,391,747	+21.0	-0.5
IA....	86.9	14	19	+128,226	+6.9	-1.6
VA....	84.7	15	16	+573,385	+16.5	+7.5
AL....	84.2	16	32	+1,110,041	+61.1	+3.8
KY....	83.2	17	10	+8,191	+0.3	+1.8
MN....	81.3	18	7	+1,736	+0.1	+3.1
TN....	80.4	19	15	-43,344	-1.5	+4.2
RI....	80.1	20	5	+42,648	+6.1	+2.5
AK....	76.9	21	23	+77,823	+33.3	+31.6
PR....	76.7	22	8	+205,686	+8.9	+2.5
NC....	74.9	23	33	+672,706	+25.3	+7.2
MO....	71.0	24	26	+425,884	+15.9	+2.7
NY....	70.0	25	12	-25,999	-0.2	+1.2
NM....	66.9	26	20	-23,775	-2.9	+12.7
DE....	66.7	27	11	+21,850	+5.5	+5.4
WV....	65.1	28	24	+49,464	+4.5	-1.2
TX....	60.5	29	25	+2,004,905	+25.1	+16.2
VT....	60.2	30	37	+54,146	+28.4	+5.2
NE....	59.9	31	31	-194,454	-25.7	+2.0
OK....	59.7	32	27	-32,244	-2.0	+9.3
AR....	58.6	33	35	+262,736	+28.8	+3.5
PA....	53.5	34	34	+265,204	+5.3	+0.1
MA....	53.4	35	30	+273,941	+9.7	+1.6
LA....	50.8	36	41	+771,224	+63.9	+6.9
ME....	50.7	37	38	-1,626	-0.4	+3.9
FL....	47.4	38	40	+2,022,789	+71.3	+18.4
MS....	47.0	39	39	+239,604	+28.1	+3.9
WA....	40.8	40	36	-64,340	-4.0	+7.4
KS....	40.0	41	28	-200,700	-17.0	+3.9
ID....	33.7	42	43	+21,551	+10.1	+6.3
WY....	29.5	43	44	+10,937	+10.5	+8.1
MT....	29.0	44	45	+7,536	+4.8	+4.4
OR....	24.5	45	47	+77,425	+19.0	+2.3
AZ....	20.6	46	42	-99,538	-14.0	+19.0
NH....	16.7	47	49	+639	+0.5	+10.0
CA....	16.6	48	46	+106,621	+2.6	+12.7
HI....	16.0	49	50	+82,036	+135.5	+9.6
NJ....	15.4	50	48	+158,607	+15.7	+3.1
UT....	2.0	51	52	+1,027	+3.2	+13.3
NV....	1.8	52	51	-4,222	-20.1	+19.1

¹1980 census report and 1985 census estimates.

State House of Representatives approval and is close to achieving Senate concurrence. Moreover, several other States and communities have shown renewed interest in fluoridation as a result of the publicity generated by the Pennsylvania and Hawaii efforts.

Because most States do not mandate fluoridation and

Table 3. Community fluoridation decisions: comparison of method with outcome, 1980 to 1989¹

Year	Referenda				Governing body			
	Number		Percent		Number		Percent	
	Yes	No	Yes	No	Yes	No	Yes	No
1980.....	7	33	18	82	19	14	58	42
1981.....	4	10	29	71	26	8	76	24
1982.....	6	13	32	68	28	6	82	18
1983.....	6	13	32	68	20	14	59	41
1984.....	6	5	55	45	37	4	90	10
1985.....	5	4	56	44	15	4	79	21
1986.....	6	9	40	60	21	4	84	16
1987.....	4	3	57	43	18	5	78	22
1988.....	10	6	62.5	37.5	15	0	100	0
1989.....	6	7	46	54	21	2	91	9
Totals..	60	103	37	63	220	61	78	22

¹Data collected from newspaper articles, reports of individuals, and newspaper clipping services. Actual number of decisions may be underreported.

no national fluoridation law has been enacted, successful fluoridation efforts tend to result from a curious mixture of activities of State and local health departments, local or State dental, medical, and allied health professional societies, community organizations, and individual citizens, attempting to influence mayors, city councils, voters, or public utility boards. Much of these State and local activities occur with the encouragement and assistance of various Public Health Service agencies such as the Centers for Disease Control, the Indian Health Service, and the National Institutes of Health.

Authorization to fluoridate a public water supply can be established by administrative decision (city or county executive, public utility board, and so forth), by governing body legislation, or by voter initiative. Governing body decisions are sometimes subjected to voter referenda to affirm or reverse the original legislative decision to fluoridate.

It has become quite clear that a substantial difference exists in the potential for success when the results of governing body decisions are compared to the results of such decisions that are subsequently subjected to voter referenda. During a recent 10-year period, as illustrated in table 3, 78 percent of fluoridation initiatives were successful when only the governing body was involved in the decision-making, while only 37 percent of those fluoridation initiatives subjected to voter referenda were successful (12). Clearly, the most effective means to implement fluoridation at the community level, in the absence of a State or national mandate, is to pursue promotion with the local legislative body and hope that a referendum does not ensue. A number of reasons have been documented elsewhere for the failure to approve fluoridation administratively, legislatively, or through voter approval, but they will not be discussed in this paper (13-23).

Summary and Recommendations

A review of State-reported fluoridation data continues to indicate slow progress in achieving universal fluoridation (8, 9). While some States have made significant gains in population served by fluoridated systems, others report little or no gain in the numbers of people receiving the benefits of water-borne fluoride (8, 9).

As previously stated, national fluoridation objectives are likely to remain unmet unless significant strategic changes are made at the policy and program levels of local, State, and Federal health agencies (6, 10). The adoption of an aggressive national fluoridation policy would be most helpful in ensuring the continuing implementation of water fluoridation for America's remaining unprotected public, particularly if it resulted in the coordination of efforts between State and Federal governments, between the public and private sectors, and between the professional and lay communities (6, 10). Particularly helpful would be the adoption of a national fluoridation mandate, as has been frequently suggested (10). Such a mandate would provide many States with the legal authority necessary to adopt universal fluoridation for their public water supplies. Legislation by each State requiring fluoridation would certainly be useful for all States currently not mandating fluoridation, but it would be very difficult to enact universally and would require much more in terms of effort and resources than the adoption of national legislation.

In the absence of a national mandate, serious consideration should be given to re-establishment of the national categorical fluoridation program to assist States with the costs of promoting, implementing, and evaluating fluoridation. Such federally supported State-operated programs, available prior to 1981, had been quite successful in expanding significantly the number of people benefiting from this most effective public health measure (24-32). All of the States showing gains of more than 1 million people served by fluoridated systems during the period from 1980 to 1985 (table 2) had at least one full time-equivalent person coordinating some form of fluoridation activities. The fluoridation coordinator's salary often was supported directly by Federal fluoridation monies (24-32). Furthermore, most of the States showing significant gains in population served by fluoridated water were States that originally received the fluoridation categorical funds to support their programs. Some of the States supplemented their Federal dollars with State funds (24-32). On the other hand, many of those States demonstrating very small increases in fluoridated populations or showing losses in the numbers of people on fluoridated systems had not received Federal fluoridation grants and had not committed much in terms of State support for fluoridation activities (24-32).

Additional Federal activities needed involve the funding of scientific research to continue evaluating the safety, effectiveness, and efficiency of fluoridation, as well as the funding of research to develop ways of eliminating barriers to the transfer of fluoridation technology to the consumer. Other Federal initiatives are needed to collect, analyze, and distribute information pertaining to the demographic, scientific, legal, and engineering aspects of fluoridation. Additional efforts are needed to improve the voluntary monitoring and surveillance system currently operated by the Centers for Disease Control and the Association of State and Territorial Dental Directors, with some consideration being given to developing mandatory testing and reporting systems to ensure that fluoridating water systems maintain continuously optimal levels of fluoride for their customers. Improved State-operated training programs for water plant operators would also lead to better compliance with proper fluoridation criteria. Finally, the expansion in the availability of technical assistance from appropriate Federal agencies to State dental health programs is critical to the States' potential success in contributing to attainment of the national health objectives for fluoridation being developed for the year 2000 (7).

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